

Remarks

By the above amendment, the Applicant has amended the claims to more succinctly define the invention for which protection is sought and to address objections that were presented by the Patent Office in the Office Action.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned **Version with markings to show changes made.**

In response to the Patent Office's comments under the heading "Information Disclosure Statement" that appears on page 2 of the Action, the Applicant submits a new Information Disclosure Statement herewith in which the reference "AH" is correctly identified. The original reference AH may be deleted.

In response to the Patent Office's comments under the heading "Drawings" that appears on page 2 of the Action, the Applicant is presently preparing a new set of drawings which will comply with the Notice of Draftsperson's Review included with the Action. This new set of drawings will be submitted as soon as possible by means of a Supplemental Response to Office Action.

Response to Claim Objections

In response to the Patent Office's comments under the heading "Claim Objections" that appears on page 3 of the Action, the Applicant submits that the informalities identified by the Patent Office have been addressed by the above claim Amendment.

R s p o n s t o R j c t i o n s

Response to §102 Rejections Based Upon Hornstra

In paragraphs 7 through 13 on pages 3 through 5 of the Action, the Patent Office rejects claims 1-8, 10, 14-23, 41, 42 ,and 44 under 35 U.S.C. 102(b) as anticipated by U.S. patent 4,649,557 of Hornstra, et al. (herein "Hornstra"). However, the Applicant respectfully submits that this rejection based upon Hornstra is inappropriate.

The Applicant respectfully reminds the Patent Office that it is well settled in the law that a claimed invention is not anticipated unless a single prior art reference discloses: (1) all the same elements of the claimed invention; (2) all these elements found in exactly the same situation as the claimed invention; (3) all the elements united in the same way as the claimed invention; and (4) all the elements performing the identical function as the claimed invention. Since one or more of the applicants' claimed elements is missing from Hornstra or do not form the same identical function as the apparatus of Hornstra, the Applicant respectfully submits that Hornstra does not anticipate the Applicant's claimed invention.

With respect to the rejection of claim 1, the Applicant believes it is instructive to review the teachings of Hornstra. The invention of Hornstra is disclosed most clearly in the only Figure of Hornstra and its description that appears at 3:57-65. As described in this passage and illustrated in the Figure, Hornstra discloses a device having an x-ray source 5 which provides x-rays directly onto specimen 6. The Applicant notes that no redirection or diffraction of the x-rays occurs between source 5 and specimen 6 in Hornstra. According to the device of Hornstra, the x-rays emitted by specimen 6 are directed along a ray 7 through a slit 3 toward crystal 1. The x-rays 7 from specimen 6 are then diffracted by crystal 1 and directed through slit 4 to detector 8. As described at 2:31-37, crystal 1 is a monochromator which provides "a high resolution [and] a high radiation efficiency" - there is no disclosure or suggestion in Hornstra that crystal 1 focuses x-rays in any way. Clearly, the apparatus of Hornstra is an apparatus for directing x-rays having a diffracting

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crystal 1 that improves the resolution and efficiency of the x-rays emitted by specimen 6 and directed toward detector 8.

The Applicant submits that the apparatus of Hornstra does not anticipate the apparatus of claim 1. First, the apparatus of Hornstra is not a "total-reflection x-ray fluorescence apparatus". Contrary to the statement made by the Patent Office in the sentence bridging pages 3 and 4 of the Action, "total-reflection x-ray fluorescence apparatus" is not "merely a 'label'". The expression "total-reflection x-ray fluorescence", which is commonly abbreviated "TXRF," is a term of the art. As described in the instant application under the heading "Background of the Invention," TXRF is an analytical method in which x-rays are directed upon an optically-reflective surface and are totally reflected, that is, with little or no scatter or absorption of x-rays due to the surface. With little or no x-ray scatter or absorption that can produce undesirable background x-rays, TXRF provides high sensitivity for measuring ultra-trace elements. (See also 3:13-30 Tiffin for a discussion of the merits of TXRF analysis.)

The apparatus disclosed by Hornstra appears to be a conventional x-ray fluorescence analysis system. There is no suggestion in Hornstra that TXRF is the mechanism of x-ray analysis. In fact, the configuration of x-ray source 5 and specimen 6 strongly suggests that the analysis mechanism of Hornstra is not TXRF. As described in the instant application TXRF is characterized by low angles of incidence or grazing angle of the x-rays on the surface, for example, see Figure 3, where the incident angle δ appears. As disclosed on in the paragraph bridging pages 9 and 10 of the present application, angle δ is typically less than 0.50 degrees. However, as shown in the Figure of Hornstra, the incident angle of the x-rays from source 5 on specimen 6 appear to be about 90 degrees, that is, the x-rays do not "graze" specimen 6 at all. Clearly, the device of Hornstra does not effect TXRF, nor could the device of Hornstra effect TXRF without a gross repositioning of the source, specimen, and crystal disclosed in Hornstra. Thus, neither TXRF nor the repositioning of the components of Hornstra to effect TXRF are disclosed or in anyway suggested by what is disclosed in Hornstra. For this reason alone, Hornstra does not anticipate the invention recited in claim 1.

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Second, there is no disclosure whatsoever in Hornstra concerning the nature of specimen 6 shown in the Figure. The entire reference to specimen 6 in Hornstra appears at 3:59-60: "An x-ray tube 5 is arranged to irradiate a specimen 6." Nothing in this sentence or anywhere else in Hornstra suggests that specimen 6 is a surface or a surface that is being analyzed by means of TXRF. Again, lacking this disclosure, Hornstra does not anticipate the invention recited in claim 1.

In addition, contrary to the invention recited in claim 1, the apparatus of Hornstra provides x-rays from source 5 directly upon specimen 6. That is, unlike the invention of claim 1, crystal 1 of Hornstra does not diffract x-rays provided by the source of x-rays. Crystal 1 of Hornstra diffracts x-rays emanating from specimen 6. For this reason, again, the Applicant submits that Hornstra does not anticipate the invention recited in claim 1. Furthermore, there is no teaching or suggestion in Hornstra that crystal 1 can or should be positioned between source 5 and specimen 6.

Also, nowhere is it disclosed or suggested in Hornstra that the x-rays diffracted by crystal 1 are in anyway focused as described in claim 1. As noted above, crystal 1 of Hornstra is a monochromator which provides "a high resolution [and] a high radiation efficiency" - there is no teaching or suggestion that crystal 1 focuses x-rays in any way, that is, concentrates the energy of the x-rays in a focused beam. Again, lacking this disclosure, Hornstra does not anticipate the invention recited in claim 1.

Therefore, since the disclosure of Hornstra does not disclose an apparatus for practicing Total X-ray Fluorescence, does not disclose that the irradiated specimen is a surface, does not position the diffracting crystal between the x-ray source and the specimen, and does not disclose a doubly-curved crystal that focuses x-rays, the rejection based upon anticipation by Hornstra is inappropriate. The Applicant respectfully requests that the rejection of claim 1, and its dependent claims 3-8, 10, 14-17, 41, 42, and 44, based upon anticipation by Hornstra be reconsidered.

Furthermore, the Applicant submits that since the apparatus of Hornstra does not teach or suggest the use of Total X-ray Fluorescence, does not teach or suggest that the

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irradiated specimen be a surface, does not teach or suggest that the diffracting crystal be positioned between the x-ray source and the specimen, and does not teach or suggest that the doubly-curved crystal may focus x-rays, the present invention is not taught or suggested by Hornstra.

The Applicant also respectfully submits that the rejection of independent method claim 18 due to anticipation based upon Hornstra is inappropriate for the same reasons the rejection of claim 1 is inappropriate. Specifically, nowhere in Hornstra are x-rays diffracted by a doubly-curved crystal and impinged upon a surface having foreign matter. Crystal 1 of Hornstra diffracts and impinges x-rays on detector 8, not specimen 6. The Applicant also respectfully requests that the rejection of claim 18, and its dependent claims 21-23, based upon anticipation by Hornstra be reconsidered.

Response to §103 Rejection Based Upon Hornstra and Tiffin

In paragraphs 14 through 17 on pages 5 through 7 of the Action, the Patent Office rejects claims 11-13, 24, 43, and 46-48 under 35 U.S.C. 103(a) as obvious in view of Hornstra and U.S. Patent 5,742,658 of Tiffin, et al. (herein "Tiffin"). However, the Applicant respectfully submits that this rejection is also inappropriate. Claims 11-13, 24, 43, and 46-47 are dependent claims dependent upon either claim 1 or claim 18. As discussed above, the inventions recited in claims 1 and 18 are neither taught or suggested in anyway by the disclosure of Hornstra. Therefore, since claims 11-13, 24, 43, and 46-47 are dependent upon claims 1 and 18, the inventions recited in claims 11-13, 24, 43, and 46-47 are inherently not taught or suggested by Hornstra or any combination of Hornstra and Tiffin.

For example, Tiffin does not provide the teachings missing from Hornstra. Tiffin discloses an x-ray detector for detecting fluorescent x-rays from a specimen and an TXRF system which includes a monochromating crystal. Tiffin does not disclose a doubly-curved crystal; the crystal 88 of Tiffin is a "multilayer monochromator", but nothing in Tiffin suggests that crystal 88 is doubly-curved.

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Furthermore, contrary to the comments of the Patent Office on the last paragraph on page 7 of the Action, even if the crystal of Hornstra were substituted for the monochromator of Tiffin, the present invention would not ensue. Nowhere in Hornstra or Tiffin is it suggested that their respective crystals in anyway focus x-rays. As discussed above, crystal 1 of Hornstra does not focus x-rays and there is no teaching or suggestion in Tiffin that monochromator 88 focuses x-rays.

Reconsideration of the rejection of claims 11-13, 24, 43, and 46-48 as obvious in view of Hornstra and Tiffin is respectfully requested.

The Applicant assumes that since no rejection of claim 9 appears in the Action that claim 9 comprises allowable subject matter.

The Applicant believes that the application is in allowable form. Early passage of the subject application to issue is earnestly solicited. Should any matters remain outstanding, it is requested that the undersigned agent be given a call so that such matters may be worked out and the patent placed in condition for allowance without the necessity of another Action.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

Claim 1 has been amended as follows:

1. (Amended) A total-reflection x-ray fluorescence apparatus comprising:
an x-ray source for providing x-rays;
a doubly-curved x-ray optic for diffracting - - **and focusing** - - the x-rays -- **provided by the x-ray source** -- ;
a surface onto which at least some of the diffracted - - **and focused** - - x-rays are directed; and
an x-ray detector for detecting resultant x-ray fluorescence emitted by any foreign matter present on the surface.

Claim 2 has been deleted.

Claim 3 has been amended as follows:

3. (Amended) An apparatus as recited in claim 1 wherein the doubly-curved - - **x-ray** - - optic is a crystal or multi-layer - - **x-ray** - - optic.

Claim 7 has been amended as follows:

7. (Amended) An apparatus as recited in claim 6 wherein the one or more apertures are positioned [**at at least one of**] before the x-ray optic [**and after th x-ray optic**].

Claim 18 has been amended as follows:

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18. (Amended) A method for detecting presence of foreign matter on a surface - - **by total x-ray diffraction** - - using a doubly-curved x-ray optic, comprising:

providing a source of x-rays;

diffracting - - **and focusing** - - at least some of the x-rays using a doubly-curved x-ray optic and impinging the diffracted - - **and focused** - - x-rays upon the surface; - - **and** - -

detecting fluorescent x-rays responsive to the impingement from any foreign matter present on the surface.

Claims 19 and 20 have been deleted.

Claim 23 has been amended as follows:

23. A method as recited in claim 22, wherein the passing through at least one aperture is practiced **[at at least one of:]** before the x-ray optic **[or after the x-ray optic]**.

Claim 41 has been amended as follows:

41. (Amended) An apparatus as recited in claim 1 wherein the x-ray source and the point of impingement upon the surface define an optic circle of radius R , and wherein the doubly-curved x-ray optic comprises a surface and a plurality of atomic planes of radius R_p which intersect the surface at an angle α ; and wherein the radius of the atomic planes R_p of the doubly-curved - - **x-ray** - - optic is defined by the equation $R_p = 2R \cos \alpha$.

Claim 44 has been amended as follows:

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44. (Amended) An apparatus as recited in claim 41, wherein the doubly-curved - - **x-ray** - - optic is curved to a toroidal, ellipsoidal, spherical, parabolic, or hyperbolic shape.

Claim 45 has been amended as follows:

45. (Amended) An apparatus as recited in claim 41, wherein the doubly-curved - - **x-ray** - - optic exhibits asymmetric Bragg diffraction.

Claim 46 has been amended as follows:

46. (Amended) An apparatus as recited in claim 41, wherein the doubly-curved - - **x-ray** - - optic also focuses the x-rays on to the surface.

Claim 47 has been amended as follows:

47. (Amended) An apparatus as in claim 46, wherein the doubly-curved - - **x-ray** - - optic focuses x-rays to a footprint on the surface and wherein the footprint comprises a largest dimension less than 1 mm.

Claim 48 has been amended as follows:

48. (Amended) An apparatus as in claim 47, wherein the doubly-curved - - **x-ray** - - optic focuses x-rays to a footprint on the surface wherein the footprint comprises a largest dimension less than 500 microns.

Claims 49 and 50 are new.